within the inverted region, and as shown by the appearance of the *v Bx* crossover type involves the region near the alleles glossy and spectacle.

Although crossing-over is an active factor in the reversion of the alleles to the wild-type, it is not possible as yet to determine the exact nature of the phenomenon. The condition can be a case of unequal crossing-over;[3] but it can as likely be a case which involves the "repeat" hypothesis developed by Bridges,[4] in which different primary loci of the chromosome are involved in the expression of the two mutants.

Summary.—1. A reversion to wild-type occurs with a frequency of 0.2% among offspring from a female which had glossy on one and spectacle on the other *X*-chromosome. Both traits are recessive and are allelic to lozenge.

2. The reversion is always associated with crossing-over.

3. The associated crossing-over occurs within the inverted regions of the chromosome, and at or near the lozenge locus.

4. The suggestion is made that the results probably involve either unequal crossing-over or crossing-over between "repeats."

[1] Oliver and Green, *Anat. Rec.*, **75** (Supp.), 100–101 (1939).

[2] Patterson and Muller, *Genetics*, **15**, 495–578 (1930).

[3] Sturtevant, *Ibid.*, **10**, 117–147 (1925).

[4] Bridges, *Jour. Heredity*, **29**, 11–13 (1938).

HD 167362, AN OBJECT SIMILAR TO CAMPBELL'S HYDROGEN ENVELOPE STAR

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Campbell's famous hydrogen envelope star[1] consists of a Wolf-Rayet nucleus of type *WC*8, which is surrounded by a nebula showing strong forbidden [N II] lines; in fact, the two red [N II] lines contribute more than Hα to the red color of the envelope. This association seems rather peculiar, the exciting Wolf-Rayet nucleus showing no trace of nitrogen,[2] whereas the nebulosity around it is very rich in nitrogen.

We have found that spectroscopically HD 167362 (CD $-30°$ 15469; MWC 288; $m = 11.8$) is a similar object. Its distance is too great to resolve the nebula, and the widths of the lines belonging to the nucleus are not as much broadened as they are in Campbell's star. The bright lines were discovered by Keeler[3] at the Harvard Observatory and were first described by Miss Fleming,[3] who called attention to the similarity with η Carinae. Miss Cannon[4] listed the spectrum among the P Cygni stars, and recorded the presence[5] of [O III] 5007 and 4959, and of other faint emission lines.[6] Miss Hoffleit[7] found no change in the apparent magnitude of the star. Merrill and co-workers[8] found that H_α is bright. C. Payne Gaposchkin and S. Gaposchkin[9] list the star among objects possessing forbidden [Fe II], but the source of their observation is not given. Our plates do not show [Fe II]. Apparently, no detailed study of this interesting spectrum has thus far been published.

Five spectrograms were obtained at the McDonald Observatory, from April 24 to May 2, 1940; three were obtained with the quartz prisms (dispersion 100 A/mm. at λ 3933) and two with the glass prisms (dispersion 50 A/mm. at λ 3933).

The spectrum consists of a weak continuum, with maximum intensity near λ 4300, on which are superimposed strong, bright lines. The forbidden lines and the lines of H seem to be a little sharper than the He I lines and He II 4686. Still broader features belong to C III and C IV. The measured lines are collected in table 1.

The object consists of a Wolf-Rayet nucleus surrounded by a nebula, and we distinguish three groups of lines, which we shall designate as *A*, *B* and *C*.

A. *Lines Originating in the Nucleus Only.*—This is the case of the broad lines of He II, C III, C IV and O III; the Wolf-Rayet nucleus is a typical carbon star; according to the intensity ratios adopted for classification purposes, the spectral type is probably later than the latest type *WC*8 in Beals' sequence. Since the band width is much smaller than 10 A and since He I plays certainly an important rôle in the nuclear part of the spectrum (see group *C*), we should be inclined[10] to assign the central star to type *WC*9. There is no trace of N II, N III, N IV or N V. Several lines of the nucleus have P Cygni character.

B. *Lines Originating in the Nebula Only.*—The forbidden lines of the following elements (in order of decreasing intensity) are observed in the nebula: [N II], [O II], [O III], [S III], [O I]. The transitions of the nebular type are much stronger than those of the auroral type (for example, in [O III] and [N II]). This is the usual thing in planetary nebulae. The transauroral transitions of [S II] may be present, but are blended with C III 4069 and O II 4076. The mean ionization from strong lines of [N II] and [O II] is around 14 volts; but the forbidden lines of neutral [O I] and doubly ionized [O III] and [S III] are fairly strong.

C. *Lines Belonging to the Nucleus and to the Nebula.*—The lines of He I and H are not exclusively of nebular origin. This conclusion is based upon the following facts: (1) The lines of [N II] and [O III] are sharper than those of He I, as may be seen from a comparison of He I 5876 and N II

TABLE 1

SPECTRUM OF HD 167362

STAR		IDENTIFICATION			
λ	Int.	Element	λ	Int.	Notes
3609.5	1*n*	C III	3609.61	5	
		C III	3608.96	4	
3682.7	1	H_{20}	3682.81		
3687.0	1	H_{19}	3686.83		
3691.3	1	H_{18}	3691.56		
3697.0	1	H_{17}	3697.15		(1)
3703.8	1–2	H_{16}	3703.85		(1)
3711.9	2	H_{15}	3711.97		(1)
3715.	0*n*	O III	3715.08	6	
3721.8	2	H_{14}	3721.94		(1)
3725.9	8	[O II]	3726.2		
3728.6	6	[O II]	3729.1		
3734.2	2	H_{13}	3734.37		
3750.4	2–3	H_{12}	3750.15		
3755.2	1	O III	3754.67	7	
3761.	1*n*	O III	3759.87	9	
3770.9	3	H_{11}	3770.63		
3791.9	1*n*	O III	3791.26	6	
3797.9	3–4	H_{10}	3797.90		
3819.4	2	He I	3819.61	4	
3835.4	4	H_9	3835.39		
3867.6	0	He I	3867.46	2	
3888.7	4	He I	3888.65	10	(4)
3889.1	4	H_8	3889.05		
3970.2	6	H_ϵ	3970.08		(1)
4026.3	2	He I	4026.19	5	
4057.0	1*n*	C III	4056.06	5	
4068.7	3*n*	C III	4067.87	9	(1)
		C III	4068.97	9–10	
		C III	4070.30	10	
		[S II]	4068.5		
4075.7	1–2	[S II]	4076.5		
		O II	4075.87	10	
4101.8	8	H_δ	4101.75		
4120.	1	He I	4120.81	3	
4144.	0	He I	4143.77	2	
4155.4	1	C III	4156.50	4	
		C III	4152.43	3	
4183.4	2*A*	C III	4187.05	10	(1)
4186.0	2*E*				
4340.7	10	H_γ	4340.48		(1)
4362.7	1	[O III]	4363.21		
4388.	1	He I	4387.93	3	
4468.7	3*A*	He I	4471.48	6	(1)
4471.3	3*E*				
4516.7	1	C III	4516.5	4	

4651.	4*nn*	C III	4647.44	20	(1, 2)
		C III	4650.26	19	
		C III	4651.48	18	
4658.8	2*n*	C IV	4658.64	5	
4667.	1*n*	C III	4665.90	6	
4686.	1*n*	He II	4685.81		
4861.3	10	H_β	4861.34		
4958.9	4*s*	[O III]	4958.91		
5006.9	7*s*	[O III]	5006.84		
5696.	3*n*	C III	5696.0	8	
5755.3	3*s*	[N II]	5755.0		
5802.	0*n*	C IV	5801.51		(3)
5876.0	5	He I	5875.62	10	
6300.	2	[O I]	6300.2		
6311.	3	[S III]	6310.2		
6548.	7	[N II]	6548.4		
6563.	15	H_α	6562.82		
6584.	10	[N II]	6583.9		
6678.	1	He I	6678.15	(6)	

Identifications in square brackets designate forbidden transitions.
1—Line showing the P Cygni character.
2—Broad line extending over 4.1 *A*.
3—For this identification see the discussion of the spectrum of NGC 6543 and its nucleus; P. Swings, *Ap. J.* (in press).
4—Blended.

5755. (2) Several lines of H and He I show P Cygni character, the velocity of ejection being practically the same as that given by the nuclear lines.

The Balmer lines are followed to H_{20} and a strong Balmer continuum extends to λ 3450.

The lines of the nucleus and of the nebula seem to have the same radial velocity. The mean value from 18 lines is −24 km./sec. The ejection velocities obtained from He I 4471 and C III 4187 are 176 and 186 km./sec., respectively. Since these values are practically equal we adopt for the ejection velocity 180 km./sec.

The great similarity of HD 167362 to Campbell's star (BD + 30° 3639 = HD 184738) is evident at once. In both cases, the nucleus is a late *WC* star and the nebula shows very strong [N II] and [O II] lines. In BD + 30° 3639, H_α is weaker than the total intensity of the two red [N II] lines, but this may not be true for HD 167362. But it should be remembered that in HD 167362, H_α belongs simultaneously to the nebula and to the nucleus; hence the relative contributions of H_α and [N II] in the nebula are probably not very different. In both stars the nucleus shows He I lines; the spectroscopic separation between nucleus and nebula is easier in the case of Campbell's star, where the two sources are clearly separated in a large telescope and where the widths of the lines are very different. In Campbell's star, He I is practically absent from the nebular part of the spectrum, while it is present in the nucleus. [O III] is strong in HD 167362, and very weak in Campbell's star.

The striking association in HD 167362 and BD + 30° 3639 of a carbon nucleus with a nitrogen envelope suggests that a comparison with NGC 6543 would be interesting, despite the higher excitation prevailing in the nuclear and nebular parts of NGC 6543.[11] This object also shows strong nebular lines of [N II], but its nucleus exhibits both N IV and C IV with similar intensities.

[1] *Astronomy and Astrophysics*, **13**, 461 (1894).

[2] Several excellent spectrograms of Campbell's star (BD + 30° 3639) have recently been secured at the McDonald Observatory and agree closely with the description of the spectrum by Wright (*Lick Obs. Pub.*, **13**, 220 (1918)); there is no trace of N II, N III, N IV or N V in the nucleus, which is a typical carbon star.

[3] *Ap. Jour.*, **2**, 354 (1895).

[4] *Harvard Ann.*, **76**, 31 (1916).

[5] *Harvard Circ.*, No. 224 (1921).

[6] Henry Draper Catalogue.

[7] *Harvard Bull.*, No. 892, 20 (1933).

[8] *Ap. Jour.*, **61**, 389 (1925); **76**, 156 (1932).

[9] "Variable Stars," *Harvard Obs. Monograph*, No. 5, 311 (1938).

[10] Beals has chosen the numbering from *WC*6 to *WC*8 so as to allow a certain latitude for new discoveries at either end of the sequence. See *Trans. I. A. U.*, **6**, 248 (1938).

[11] P. Swings, *Ap. Jour.* (in press).

THE SPECTRUM OF RW HYDRAE

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RW Hydrae[1] is an abnormal long-period variable having an unusually small range, of about one magnitude; the maximum photographic magnitude is 9.7 to 9.9 and the minimum 10.8 to 10.9. It has a late-type spectrum upon which are superimposed several bright lines. Miss Cannon's estimates of the spectral type range from *K*5 to *M*2; she noticed bright H_β, H_γ and H_δ.

The spectrum has been investigated by Merrill,[2] who observed, besides the late-type spectrum, several bright lines of H, He I, He II and [O III] (auroral transition λ 4363 only).

This object offers a striking similarity to AX Persei, CI Cygni, Z Andromedae, R Aquarii, T Coronae and others, consisting of a late-type star and of a companion of high excitation. In previous papers[3] we have given a